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## **Comments on: Games with a permission structure - A survey on generalizations and applications**

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# Comment on

## “Games with a permission structure: A survey on generalizations and applications”

Robert P. Gilles\*

October 17, 2016

### 1 Hierarchical restrictions on coalition formation

Van den Brink’s excellent survey brings together many established insights of how the exercise of hierarchical authority affects the allocation of generated wealth among cooperative participants in the hierarchy. In particular, the survey considers the effects of three different institutional rules through which authority is exercised. Under the *conjunctive permission rule*, every player has to obtain permission from all her superiors to participate in value-generating processes. This implies that coalitions are only formable if they contain all (direct and indirect) superiors of its members. The *disjunctive permission rule* imposes that players obtain permission from at least one superior, limiting the authority that these superiors can exercise. Finally, under the *local permission rule*, the scope of authority is reduced further in that players only have to obtain permission from their direct superiors to participate in such value-generating processes. In this latter environment, authority is exercised directly only rather than directly and indirectly as is the case under the conjunctive and disjunctive permission rules.

These permission rules can be represented as imposing certain restrictions on coalition formation, particularly captured through an *antimatroid*—defined as a collection of formable coalitions in the player set  $N$  that is closed under taking finite unions and satisfies accessibility.<sup>1</sup> In particular, under the conjunctive permission rule, the antimatroid is additionally closed under finite intersections. Similarly, the disjunctive permission rule imposes certain other additional properties on the antimatroid of formable coalitions.

In the axiomatic theories considered in this survey, the permission rules are not considered from the viewpoint of facilitating cooperation, but rather from the viewpoint that these rules restrict

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<sup>1</sup>A collection of formable coalitions is *accessible* if for every formable coalition  $E \neq \emptyset$ , there exists  $i \in E$  such that  $E \setminus \{i\}$  is formable as well.

or hinder such cooperation. The transferable utility game thus represents the values that could be generated through free cooperation among the players, while the antimatroid of formable coalitions imposes restrictions on cooperation and makes certain value generating processes inaccessible to these players.

One natural question that arises within the context of these theories is why such hierarchical authority structures—represented by these three institutional permission rules—would emerge. Why are such hierarchical authority structures so prevalent in our societies if they are mainly restricting accessibility to value generating processes? The answer to this question has to be that these hierarchical authority structures and permission rules actually facilitate the generation of economic values through cooperation rather than hinder it.<sup>2</sup>

There are two types of hierarchical structures in which authority is exercised in a similar fashion as described in the three institutional permission rules discussed in this survey. The first type is that of social hierarchies that have been prevalent in human societies since the onset of the emergence of Homo Sapiens. Second, since the industrial revolution there have emerged hierarchically structure social production organizations, also known as firms or corporations. In both types of organizational structure, authority is exercised through instructions and commands from hierarchical superiors to hierarchical subordinates.

Below I discuss both types of hierarchical organization structures and their function as facilitators of economic value generating processes. I conclude by drawing some conclusions for a research agenda for the full development of mathematical models of such organizations.

## 2 The role of hierarchies in the social economy

Social hierarchies are arrangements among economic decision makers in which social standing allows the exercise of authority by socially higher ranked individuals over socially lower ranked individuals. There is significant evidence that such social hierarchies form the backbone of economic communities throughout human history (Graeber, 2011; Bowles & Choi, 2013, 2016; Bowles, 2015). Particularly, these social hierarchies introduce institutional frameworks that impose *stability* in the economy's wealth generation processes. Stoelhorst & Richerson (2013) and Kaufman (2003) point out that institutional rules and social guides, which prescribe the domains of socio-economic decision making, act as stabilizers that facilitate well-functioning economic wealth generating processes.

Gilles et al. (2015) show through a formal model of a network economy that institutional arrangements based on social hierarchical leadership restrict interactions among players appropriately to facilitate the emergence of a stable state in the economy and the wealth generating processes that it encapsulates. In this model economic agents are able to act as market makers and to create markets as trade platforms in a given network of trade or social relationships. Social hierarchies provide the

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<sup>2</sup>The cooperative nature of the human economy has been emphasised throughout history. I refer to, e.g., Plato (2007), Seabright (2010), Bowles & Gintis (2011) and Sun (2012) for empirical support of human sociality and the history of these ideas.

required conditions on the allowable interactions in the network to guarantee the emergence of the required stability to form such platforms in the maximally effective and efficient fashion.

Technically, Gilles et al. (2015) show that these hierarchical authority arrangements exclude the emergence of Condorcet-type cycles in the interaction structures that obstruct the stability of the formed platforms. Thus, hierarchical authority prevents inconsequential, cyclic decision making by blocking the formation of such cycles. This analysis can be extended to include other forms of socio-economic cooperation structures, in particular social arrangements in which hierarchical authority is exercised locally (Lazarova, 2006).

In related research, Piccione & Rubinstein (2007) refer to the sheer efficiency of social hierarchical arrangements in the trade of commodities. Graeber (2011) points out that such hierarchical arrangements have been prevalent in hunter-gatherer societies and are closely tied to the presence of debt arrangements in such societies. Both refer to such social hierarchies as effective institutional arrangements to achieve efficient socio-economic states in a community of human cooperators.

In the incorporated, capitalist economy that arose after the industrial revolution, the beneficial role of hierarchical social production organizations—or “firms”—has been less well understood. Coase (1937) seminally pointed out that hierarchical production organizations facilitate the reduction of transaction and networking costs. In that regard, firms act as collective shelters against the costs of market making and relationship building. This is captured in the multi-faceted and incomplete nature of the employment relationship.

More recently, research has turned to understanding enhanced property rights as the main institutional innovation that facilitated the rise of firms and the incorporated, capitalist economy (Hart & Moore, 1990, 1999). This has parallels with the emergence of social hierarchies after the introduction of agricultural property rights during the agricultural revolution as argued by Bowles & Choi (2013) and Bowles (2015).

Finally, I point out that hierarchies can be viewed as effective information processing structures. This approach is closely related to the theory of decentralized computing and has been seminally developed by Radner (1992, 1993) and Van Zandt & Radner (2001). This approach is founded on the hypothesis that workers are endowed with limited capabilities to process information and need to be organized in hierarchical structures to process significant quantities of data and make effective decisions.

### 3 Topics for further research

From this discussion there emerge a number of pertinent and deep research questions that relate to the cooperative game theory of hierarchical permission structures as surveyed by van den Brink.

- There are strong indications that hierarchical authority has significant benefits for the stable generation of economic wealth. Could one formulate a mathematical, game theoretical framework that clearly identifies the causes of this feature? This would require the modelling

of economic wealth creation processes through cooperative games—as surveyed here—and, additionally, the mathematical formulation of the costs of networking and making transactions. Hierarchical constraints on free interaction should ideally lead to stability and more successful wealth creation. The models outlined in Coase (1937) and Gilles et al. (2015), enhanced by the models surveyed by van den Brink, could function as guides for such a development.

- Second, as pointed out above, there are indications that social hierarchies as well as hierarchically structured firms are founded on institutional property rights. The mathematical modelling of property rights has been recognized as extremely difficult. However, the methodology used in the approach of cooperative games with permission structures might be a welcome guide to model property rights more precisely. This has been attempted in Brink & Gilles (2016) for the case of arbitrarily complex hierarchies of principal-agent relationships. Further development of similar models could bring new insights into the nature of the firm as well as social hierarchies.
- There is a third research question emerging from this short overview of approaches to the benefits from the exercise of hierarchical authority. Indeed, if hierarchies are also effective due to the bounded abilities and rationality of human decision makers, then the merging of these features to hierarchies and their understanding from the idea of socio-economic institutions such as property rights should eventually result in a rather complete perspective on why hierarchies exist in human societies and economies. This clearly is a question that seems to be the most difficult to answer. However, it is clear that the use of cooperative games to describe the fundamental wealth generating processes in these hierarchies is mandated to even contemplating this question.

In this comment I have argued for a very broad and positive perspective on the use of cooperative game theory to understand why hierarchies are so prevalent in human economic wealth creation processes. The theories surveyed by van den Brink should form the foundation for such expanded efforts and support the development of mathematical approaches to institutional and organizational explanations of how human economies are structured.

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